
XI. Science and Technology/Engineering, Grade 8 □

Grade 8 Science and Technology/Engineering Test

The spring 2005 Grade 8 MCAS Science and Technology/Engineering Test was based on learning standards in the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2001). The *Framework* identifies four major content strands listed below. Page numbers for the grade 6–8 learning standards appear in parentheses.

- Earth and Space Science (*Framework*, pages 29–30)
- Life Science (Biology) (*Framework*, pages 46–48)
- Physical Sciences (Chemistry and Physics) (*Framework*, pages 60–62)
- Technology/Engineering (*Framework*, pages 76–79)

The *Science and Technology/Engineering Curriculum Framework* is available on the Department Web site at www.doe.mass.edu/frameworks/scitech/2001/0501.pdf.

In *Test Item Analysis Reports* and on the *Subject Area Subscore* pages of the MCAS *School Reports* and *District Reports*, Science and Technology/Engineering test results are reported under four MCAS reporting categories, which are identical to the four *Curriculum Framework* content strands listed above.

Test Sessions and Content Overview

The MCAS Grade 8 Science and Technology/Engineering Test included two separate test sessions. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

The use of bilingual word-to-word dictionaries was allowed for limited English proficient students only, during both Science and Technology/Engineering test sessions. No other reference tools or materials were allowed.

Cross-Reference Information

The table at the conclusion of this chapter indicates each item's reporting category and the *Framework* learning standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.

Science and Technology/Engineering □

SESSION 1

DIRECTIONS

This session contains seventeen multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

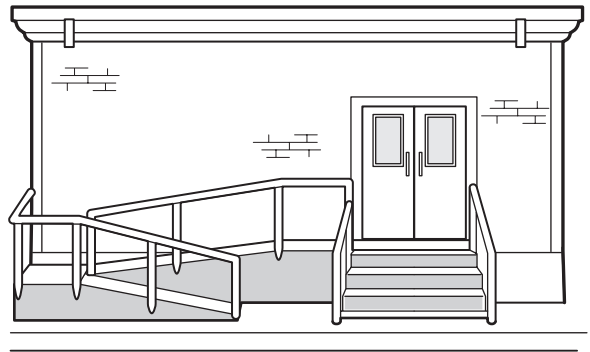
- 1 While hiking through Granville State Forest, a student finds an unusual plant-like organism that appears to lack chlorophyll. When the student examines a sample using a microscope, he sees many cells with cell walls and no chloroplasts.

This organism is **most likely** a member of what Kingdom?

- A. Animalia
- B. Eubacteria
- C. Fungi
- D. Protista

- 2 Which of the following statements **best** explains why the lower mantle of Earth is much more rigid and dense than the upper mantle?
- A. The lower mantle is older than the upper mantle.
 - B. The lower mantle is cooler than the upper mantle.
 - C. The lower mantle is under more pressure than the upper mantle.
 - D. The lower mantle is farther from the core than the upper mantle.

- 3 The drawing below shows an entrance to a building with both steps and a ramp.



The ramp in front of this building **most likely** functions as which of the following?

- A. an assistive device
- B. a structural support
- C. a prosthetic device
- D. a suspension system

- 4 Which of the following is an example of a physical change?
- A. lighting a match
 - B. breaking a glass
 - C. burning of gasoline
 - D. rusting of iron

- 5 Mercury, the planet nearest to the Sun, has extreme surface temperatures, ranging from 465°C in sunlight to -180°C in darkness.

Why is there such a large range of temperatures on Mercury?

- A. The planet is too small to hold heat.
- B. The planet is heated on only one side.
- C. The planet reflects heat from its dark side.
- D. The planet lacks an atmosphere to hold heat.

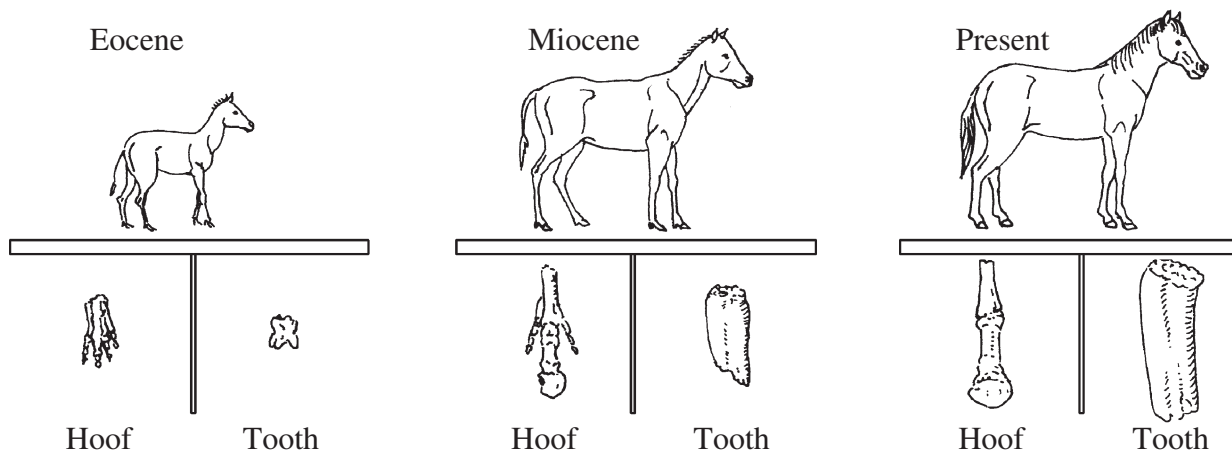
- 6 Fossilized coral reefs, fish, and other warm water marine creatures have been found in mountainous regions of New England. Which of the following **best** explains how this could have occurred?

- A. The climate and geology of this area have changed over time.
- B. These creatures were better adapted to cold climates at one time.
- C. The process of fossilization greatly changed the original material.
- D. Scavengers carried the remains of these creatures to higher regions.

- 7 When air near the ground is warmed by sunlight, which of the following occurs?

- A. The warm air radiates and becomes cool again.
- B. The warm air evaporates into the cooler air.
- C. The warm air expands and rises, resulting in convection.
- D. The warm air loses its ability to hold water and precipitates.

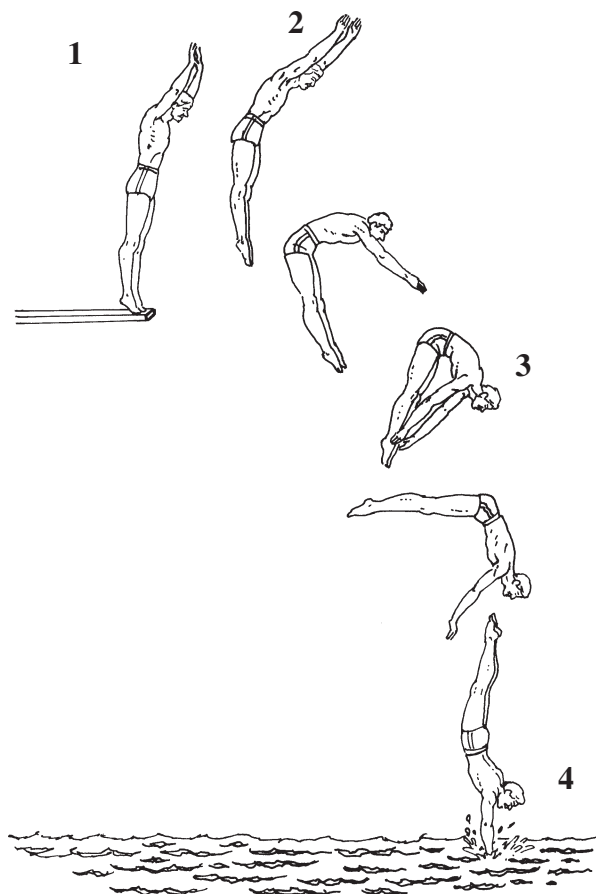
- 8 The diagram below represents part of the horse fossil record from three time periods. It includes illustrations of the hooves and teeth of horses from each time period.



Which of the following statements is **best** supported by the horse fossil record?

- A. The horse has been a carnivore.
- B. The horse has changed over time.
- C. The horse has many common ancestors.
- D. The horse has lived in the same ecosystem.

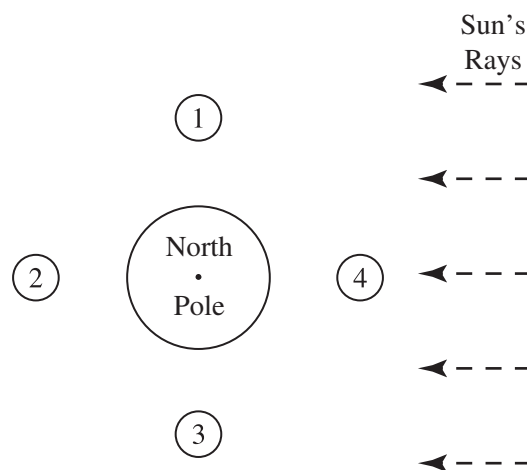
- 9 The diagram below represents a diver's motion from the top of a high diving board into a pool of water.



At which labeled point does the diver have the **least** potential energy?

- A. 1
- B. 2
- C. 3
- D. 4

- 10 The diagram below shows a polar projection of Earth and four positions of the Moon.



The highest high tides and lowest low tides are called spring tides. Which positions of the Moon produce spring tides in Earth's oceans?

- A. 1 and 2
- B. 2 and 4
- C. 1 and 3
- D. 3 and 4

- 11 The diagram below shows the path of a jet from Washington, D.C. to Dallas, TX.



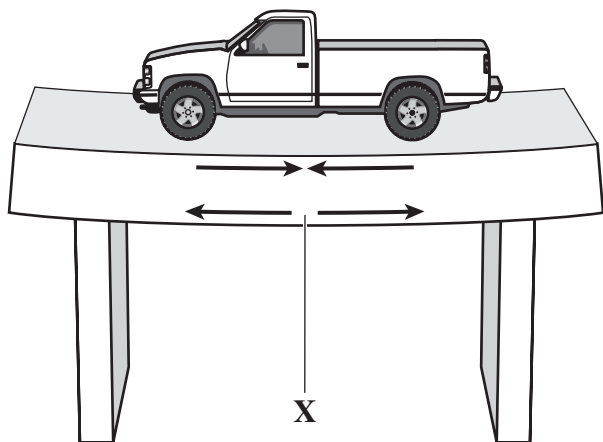
The trip takes approximately 2 hours and covers approximately 1900 km. Which of the following **best** describes the speed and direction of the jet's flight?

- A. 475 km/h southwest
- B. 950 km/h southwest
- C. 1900 km/h southwest
- D. 3800 km/h southwest

- 12 Which of the following describes a feature that is shared by Earth and the Moon?

- A. They have nearly the same atmosphere.
- B. They have almost the same gravitational pull.
- C. They have a rocky crust that includes mountains.
- D. They have areas that show considerable water erosion.

- 13 A beam bridge supporting a toy truck is shown in the diagram below.



When an object pushes down on this bridge, the bottom edge experiences a force that tends to pull it apart as shown. What is the type of force labeled X?

- A. compression
 - B. shear
 - C. tension
 - D. torsion
- 14 If 1 kg of the compound toluene melts at -95°C , then 500 g of toluene will
- A. melt at -47.5°C .
 - B. melt at -95°C .
 - C. boil at 95°C .
 - D. boil at 47.5°C .

- 15 Sulfur (S), oxygen (O_2), water (H_2O), and sodium chloride (NaCl) are all examples of pure substances. Which of the following describes **all** pure substances?

- A. A pure substance consists of only one type of element.
- B. A pure substance has a definite chemical composition.
- C. A pure substance cannot be broken down into simpler substances.
- D. A pure substance is normally found as a solid at room temperature.

- 16 The drawing below represents a bit used in a power drill.



Which of the following metals is **most** suitable for making this drill bit?

- A. aluminum
- B. copper
- C. gold
- D. steel

- 17 Which of the following is performed by the quality control division of a company that is manufacturing a chair?

- A. applying the varnish
- B. assembling the parts
- C. cutting the material
- D. inspecting the finish

DIRECTIONS

Questions 18 and 19 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

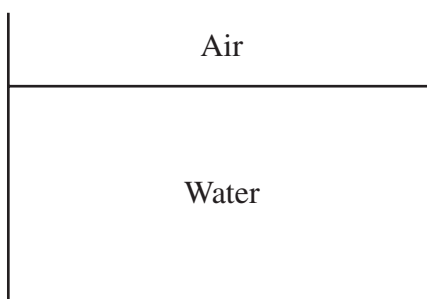
Write your answer to question 18 in the space provided in your Student Answer Booklet.

- 18** Two different bars of soap are being investigated by a group of students. They measured the mass and volume of each bar and recorded the results in the table below.

Soap	Mass (g)	Volume (cm ³)
A	110	100
B	95	100

Density of water = 1.0 g/cm³

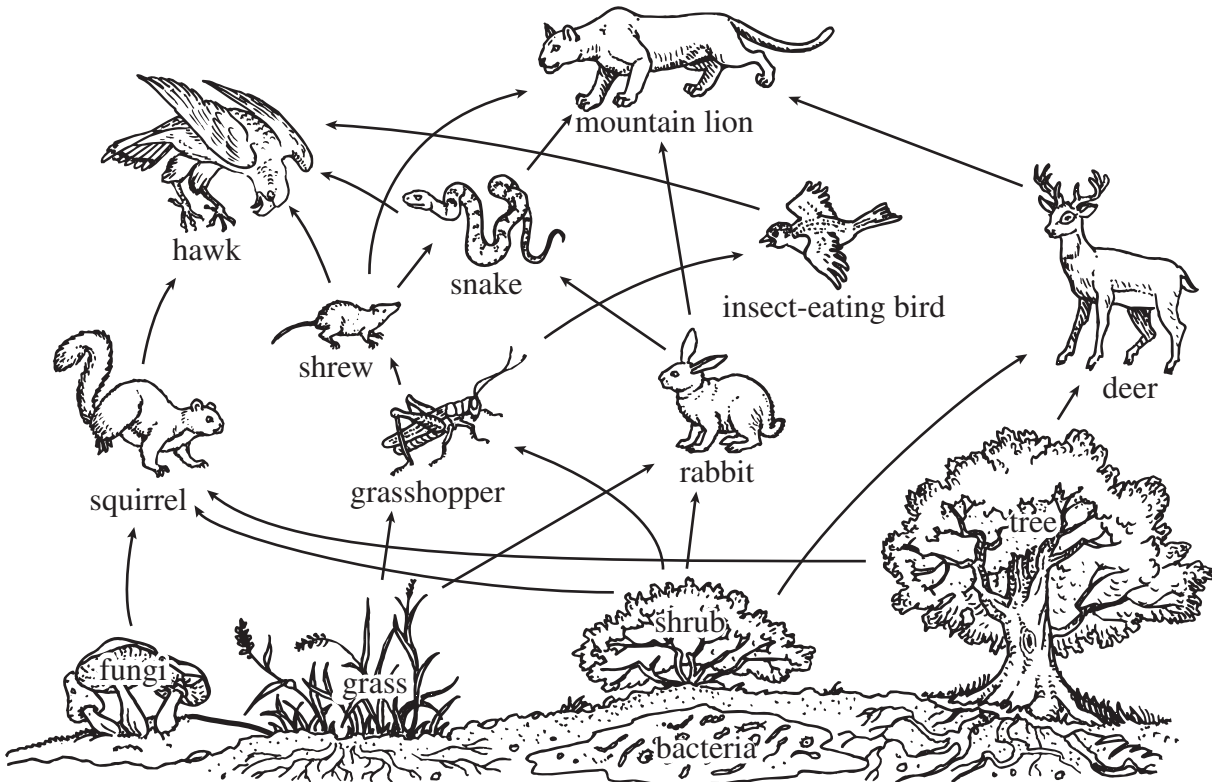
- a. Calculate the density of each bar of soap. Show your work.
- b. The diagram below represents a container of water. In your Student Answer Booklet, copy the container of water as illustrated. Draw and label the positions that soap bar A and soap bar B would occupy if they were placed in this container.



- c. Explain why you drew each bar of soap in the position selected.

Write your answer to question 19 in the space provided in your Student Answer Booklet.

- 19 The diagram below shows a food web.



Members of this forest community get materials they need to survive from the ecosystem. These materials are constantly being recycled.

- Explain the role of grass in this food web, and include in your response why it is at the bottom of the web.
- What is the role of the grasshopper in this food web?
- Explain what would happen to the population of snakes if the rabbits were suddenly removed from this ecosystem.
- Explain what would happen to the grasshopper population if the insect-eating birds were suddenly removed from this ecosystem.

Science and Technology/Engineering ☐

SESSION 2

DIRECTIONS

This session contains seventeen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

- 20 How many different elements are in the compound sodium carbonate (Na_2CO_3)?

A. 1
B. 3
C. 6
D. 7

- 21 Lightning from a thunderstorm strikes a tree that falls to the forest floor and dies. During the next few years the dead tree undergoes many changes.

What organisms are **most likely** responsible for the biological and chemical changes to the tree?

A. consumers
B. decomposers
C. predators
D. producers

- 22 The diagram below shows the supports of a proposed bridge.

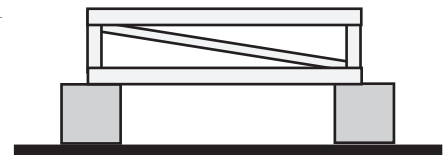


Which of the following wooden bridge designs, if built from one support to the other, would withstand the heaviest load?

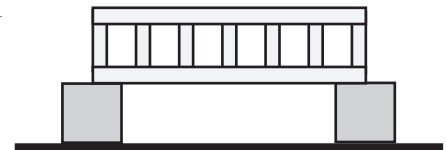
A.



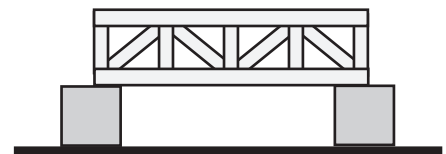
B. ☐



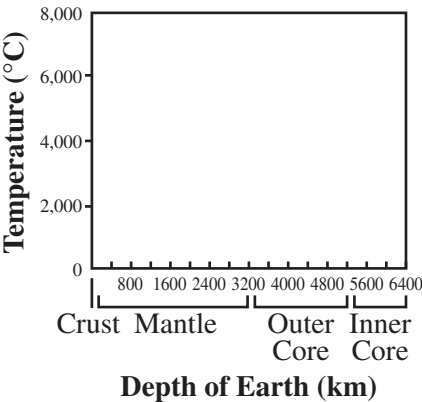
C. ☐



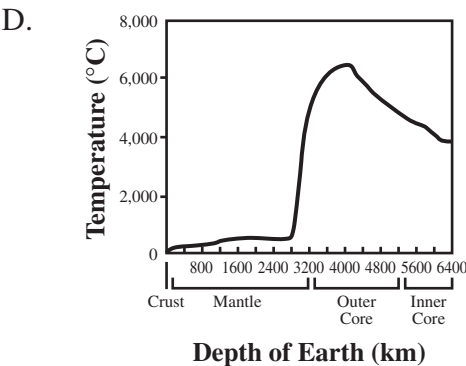
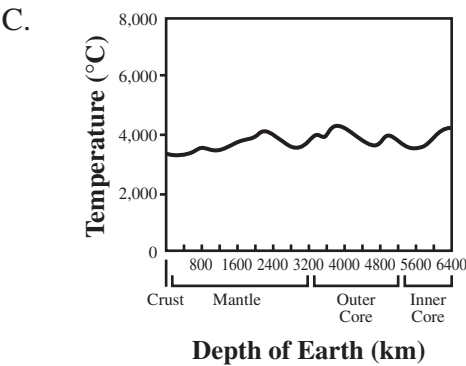
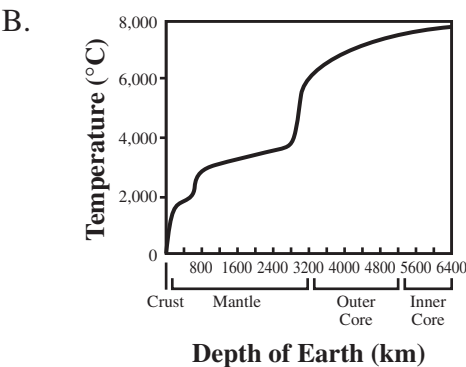
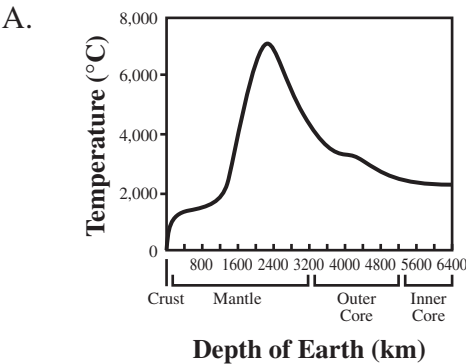
D.



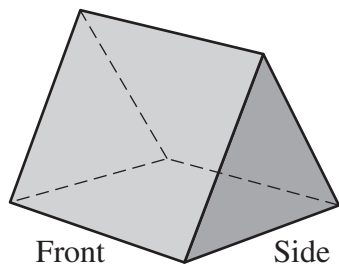
23 The axes below relate the temperature to the depth below Earth's surface.



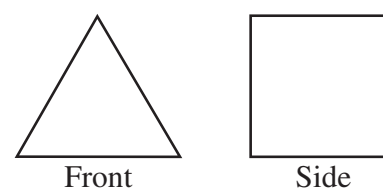
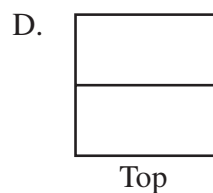
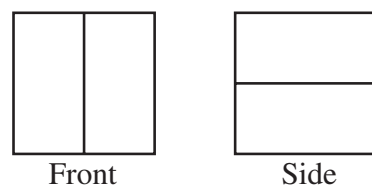
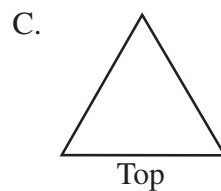
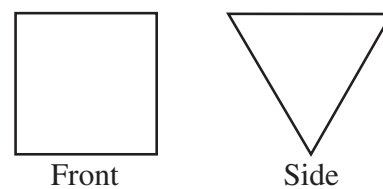
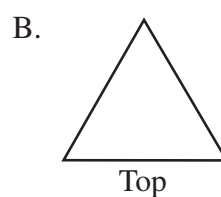
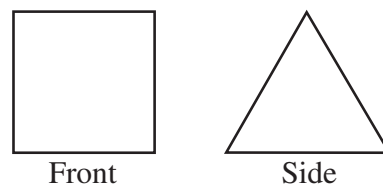
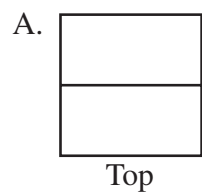
Which of the following graphs **best** represents temperatures inside Earth?



- 24 The diagram below shows a three-dimensional object.



Which of the following diagrams correctly shows an orthographic projection of this three-dimensional object?



- 25 On Earth, Johanna weighs 100 lbs. She calculated what her weight would be at several other locations in the solar system. The results are shown in the table below.

Location in Solar System	Weight (lbs.)
Venus	90
Earth	100
Moon	16
Mars	40
Jupiter	260

Which of the following statements is **best** supported by the information in the table?

- A. Venus has more gravitational force than Earth.
- B. Mars has less gravitational force than the Moon.
- C. Earth has four times the gravitational force of Mars.
- D. Jupiter has more than twice the gravitational force of Earth.

- 26 The population of which of the following organisms would **most likely** decline if small animals like rats, rabbits, and snakes were eliminated from an ecosystem?

- A. earthworms
- B. grasses
- C. hawks
- D. mushrooms

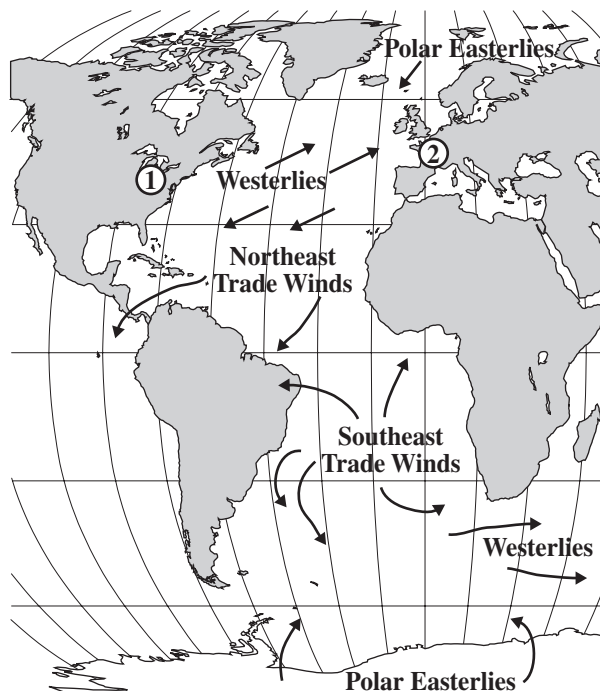
- 27 In producing an automobile, which of the following is the **best** use of a robot?

- A. to perform repetitive tasks
- B. to determine the trunk space
- C. to demonstrate passenger comfort
- D. to perform quality control inspections

- 28 Which of the following is an example of heat transfer by conduction?

- A. a whole metal spoon getting hot when one end is in hot soup
- B. the inside of a car in the sun getting very hot
- C. a tar road getting hotter in the sun than a concrete sidewalk
- D. a fireplace fire heating a room on a cold day

- 29 The diagram below illustrates the motion of prevailing winds over oceans on Earth.

**Key**

- ① Eastern United States
② Europe

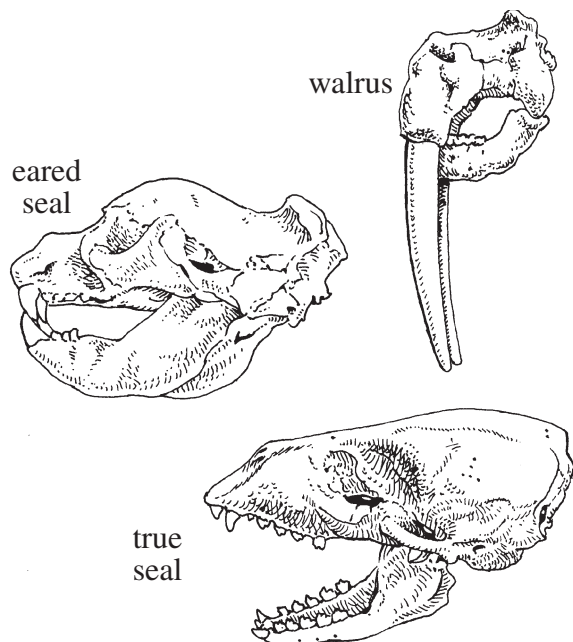
If a sailboat sailed from the eastern United States to Europe and then back, which of the following winds would **most** directly power the sailboat?

- A. Polar Easterlies going and Westerlies returning
- B. Northeast Trade Winds going and Westerlies returning
- C. Westerlies going and Northeast Trade Winds returning
- D. Southeast Trade Winds going and Northeast Trade Winds returning

- 30 Which cellular organelle uses oxygen and glucose to provide energy to the cell?

- A. mitochondrion
- B. nucleus
- C. ribosome
- D. vacuole

- 31 The drawings below show skulls of three modern animals.



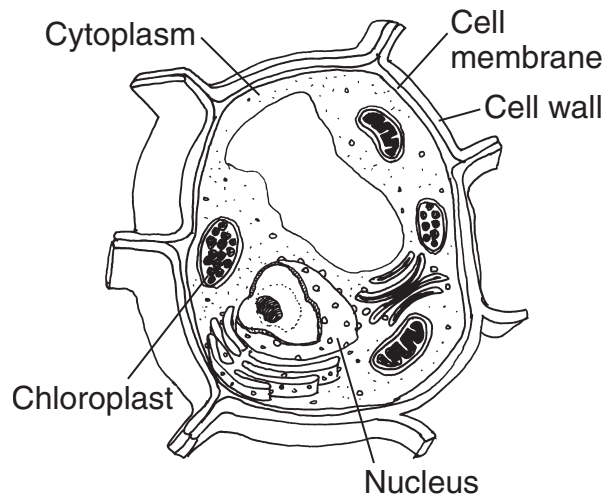
The three skulls all share characteristics with a fossil skull of an extinct seal (not shown) that is believed to be 23 million years old. What conclusion can be drawn about the relationship between the three modern animals and the fossil?

- A. They are all the same species.
- B. They share a common ancestor.
- C. They share the same food supply.
- D. They are all 23 million years old.

- 32 In order for a glider to fly, its weight must be opposed by

- A. lift.
- B. drag.
- C. gravity.
- D. friction.

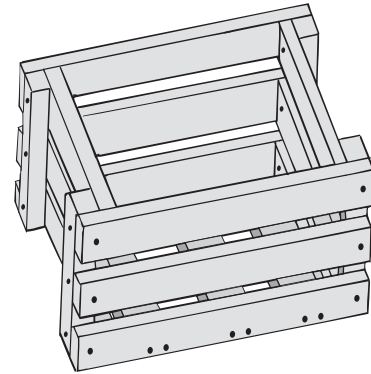
- 33 The diagram below shows a cell.



Where would this cell **most likely** be found?

- A. bark
- B. frog
- C. leaf
- D. mushroom

- 34 The drawing below shows a wooden crate.



Which of the following sets of equipment is **most** appropriate to design and construct this wooden crate?

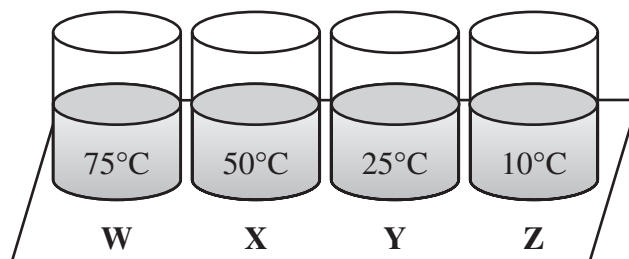
- A. hammer, wrench, electric drill, sander
- B. electric drill, nails, chisel, screwdriver
- C. measuring tape, hand saw, nails, hammer
- D. electric stapler, pliers, yardstick, screwdriver

- 35 When dense, cold air pushes beneath warmer atmospheric air, the lighter, warmer air rises. As this air rises into the atmosphere, it cools and some of the water vapor in it condenses.

Which of the following will **most likely** form as this occurs?

- A. a cloud
- B. a rainbow
- C. a sunset
- D. a tornado

- 36 Four containers of water with different temperatures are placed on a table as shown below. The temperature of the room is 25°C.



After four hours, which beaker of water will have exchanged the **most** heat energy with the environment?

- A. W
- B. X
- C. Y
- D. Z

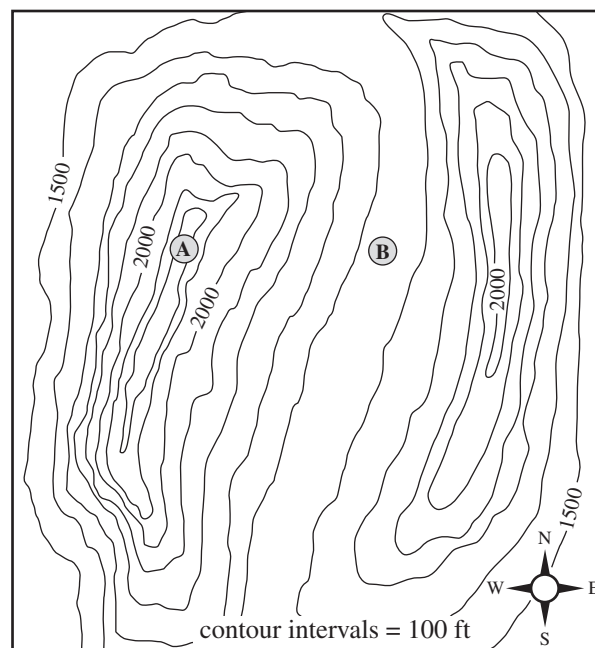
DIRECTIONS

Questions 37 through 39 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 37 in the space provided in your Student Answer Booklet.

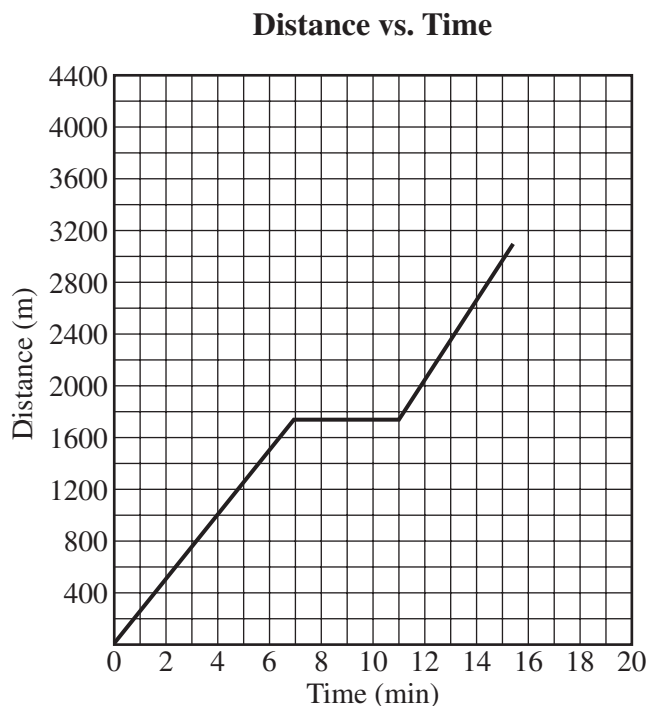
- 37** The illustration below is a topographic map with two landforms labeled A and B.



- Identify the landform shown at point A. Describe how the contour lines and elevations are used to represent the features of this landform.
- Identify the landform shown at point B. Describe how the contour lines and elevations are used to represent the features of this landform.

Write your answer to question 38 in the space provided in your Student Answer Booklet.

- 38 The graph below relates distance to time for a jogger on a morning run.

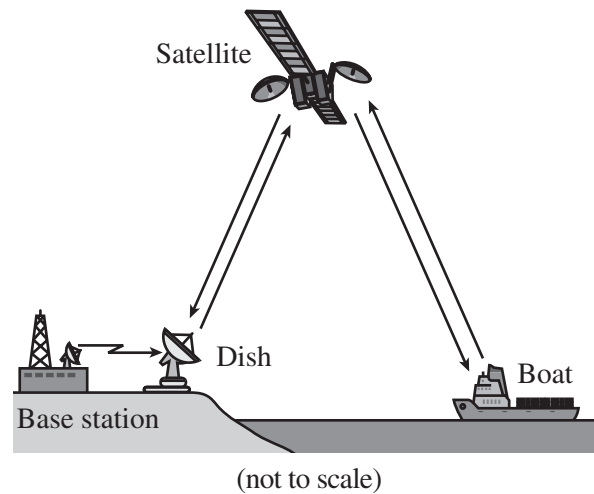


Juan is on a morning jog. His speed is represented in the graph.

- At what rate of speed is Juan running between 4 min and 6 min?
- According to this graph, what can you tell about Juan's motion between 7 min and 11 min?
- If Juan had maintained the same speed as in the first 7 min, how long would it have taken him to run 3000 m? Explain your answer.

Write your answer to question 39 in the space provided in your Student Answer Booklet.

- 39 A communication link between a Coast Guard patrol boat and its base station is shown below.



The boat uses the satellite to communicate its position to the base station.

- Explain the purpose of a decoder in a communication system.
- Identify **one** of the decoders in this system and describe how it is used.
- Explain the purpose of a transmitter in a communication system.
- Identify **one** of the examples of a transmitter in this system. For the transmitter you have identified, explain its specific role.

Grade 8 Science and Technology/Engineering
Spring 2005 Released Items:
Reporting Categories, Standards, and Correct Answers

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
1	252	<i>Life Science (Biology)</i>	1	C
2	252	<i>Earth and Space Science</i>	2	C
3	252	<i>Technology/Engineering</i>	7.1	A
4	252	<i>Physical Science (Chemistry and Physics)</i>	10	B
5	253	<i>Earth and Space Science</i>	10	D
6	253	<i>Life Science (Biology)</i>	17	A
7	253	<i>Earth and Space Science</i>	3	C
8	254	<i>Life Science (Biology)</i>	18	B
9	255	<i>Physical Science (Chemistry and Physics)</i>	13	D
10	255	<i>Earth and Space Science</i>	9	B
11	256	<i>Physical Science (Chemistry and Physics)</i>	11	B
12	256	<i>Earth and Space Science</i>	10	C
13	257	<i>Technology/Engineering</i>	5.3	C
14	257	<i>Physical Science (Chemistry and Physics)</i>	9	B
15	257	<i>Physical Science (Chemistry and Physics)</i>	8	B
16	258	<i>Technology/Engineering</i>	1.1	D
17	258	<i>Technology/Engineering</i>	4.4	D
18	259	<i>Physical Science (Chemistry and Physics)</i>	2	
19	260	<i>Life Science (Biology)</i>	14	
20	261	<i>Physical Science (Chemistry and Physics)</i>	5	B
21	261	<i>Life Science (Biology)</i>	15	B
22	261	<i>Technology/Engineering</i>	5.4	D
23	262	<i>Earth and Space Science</i>	2	B
24	263	<i>Technology/Engineering</i>	2.2	A
25	264	<i>Physical Science (Chemistry and Physics)</i>	1	D
26	264	<i>Life Science (Biology)</i>	14	C
27	264	<i>Technology/Engineering</i>	4.2	A
28	264	<i>Physical Science (Chemistry and Physics)</i>	16	A
29	265	<i>Earth and Space Science</i>	4	C
30	265	<i>Life Science (Biology)</i>	4	A
31	266	<i>Life Science (Biology)</i>	11	B
32	266	<i>Technology/Engineering</i>	6.4	A
33	267	<i>Life Science (Biology)</i>	3	C
34	267	<i>Technology/Engineering</i>	2.4	C
35	268	<i>Earth and Space Science</i>	4	A
36	268	<i>Physical Science (Chemistry and Physics)</i>	16	A
37	269	<i>Earth and Space Science</i>	1	
38	270	<i>Physical Science (Chemistry and Physics)</i>	12	
39	271	<i>Technology/Engineering</i>	3.1	

* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's Web site later this year.